FIELD SERVICE MANUAL

FOR

BALLOON COMPANIES

Translation of a French document by the Aviation Section
Signal Corps, U. S. A.
Edited at War College Division, G. S.

OCTOBER, 1917

WASHINGTON
GOVERNMENT PRINTING OFFICE
1917

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WAR DEPARTMENT,
WASHINGTON, *October 4, 1917.*

The Field Service Manual for balloon companies is published for the information of all concerned.

[062.22 A. G. O.]

BY ORDER OF THE SECRETARY OF WAR:

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OFFICIAL:

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The Adjutant General.

WAR DEPARTMENT,
THE ADJUTANT GENERAL'S OFFICE,
Washington, June 19, 1917.

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The Adjutant General.

TABLE OF CONTENTS.

FIELD SERVICE MANUAL FOR BALLOON COMPANIES.

CHAPTER 1.

TACTICAL USES OF THE BALLOON.

The balloon is an observation station from which by reason of its height and relatively fixed position in space continuous observation and immediate direct transmission of data are possible.

In order to obtain the greatest benefit from the balloon it is necessary to understand what are the best conditions for the service of this type of observing station, to understand the services which it may be required to perform for various branches of the Army, and to have a proper knowledge of the general organization and functioning of the balloon service itself.

These three subjects are explained in the following paragraphs:

CONDITIONS FOR EFFICIENCY.

The efficiency of the balloon as an observing station depends upon two factors—

1. The special ability of the observer.

2. Perfect knowledge and strict observation by the officer in charge of the balloon of the regulations for the use of the material.

A. *Observers.*—Candidates for duty as observers are chosen from those known to possess the following qualities: Physical endurance, acute vision, aptitude for orientation, and an appreciation of distances. The intellectual qualities of the candidate are also investigated. Those known to be lacking the moral qualities, such as courage, energy, and conscientiousness, are eliminated.

The candidates receive at special schools a course of instruction, professional, technical, and practical. There their progress is determined by oral and written examinations, and practical work in the care of the balloon. But only after a period of

service on the line as members of a service unit may their qualifications be definitely determined.

The precautions taken in the selection and development of observers permit them to be considered as an élite personnel, who justify the confidence which must necessarily be placed in them.

CONDITIONS FOR OPERATION.

B. *Conditions for operation.*—Influence of atmospheric conditions on the maneuvering of the balloon.

Wind.—Because of their constraint and their inclination, elongated captive balloons receive a measure of support from the wind. This results in a tension upon the cable which increases with the velocity of the wind, and in high winds is considerable (500 kilos for a wind of 10 meters per second), (1,100 pounds for a wind of 22 miles per hour), and 1,100 kilos for a wind of 20 meters (2,400 pounds for a wind of 45 miles per hour). It must be noted that the tension at the winch is less than at the balloon by an amount equal to the weight of the cable actually being supported by the balloon.

The safe limits of tension are: For normal service conditions, tension at the ground, 700 kilos (1,500 pounds approximately), which corresponds for the H balloon to the pressure of a wind of 16 meters per second (approximately 33 miles per hour).

In exceptional conditions (during attack): Tension at the ground, 350 kilos (770 pounds approximately), corresponding for the H balloon to the pressure of a wind of 18 meters per second (40 miles per hour approximately).

A wind of 16 meters per second subjects the car of the H balloon to shocks which render observation very difficult, but in the M balloon observation with field glasses is possible in a wind of 18 meters per second.

The elongated balloons suffer very much from the effects of the winds, which keep them in continual movement. The suspension cordage continuously sliding over the rigging thimbles and bull's-eyes, is quite rapidly worn out. Exposure in ascensions to the winds for 12 or 14 hours in one day will render necessary a minute inspection of all parts of the rigging, and the replacement by the rigging detachment of certain ropes, and a delay between prolonged ascensions in high winds of 8 to 10 hours for inspection and repair.

MEANS OF MEASURING AND PREDICTING THE FORCE OF THE WIND.

1. *By the dynamometer.*—From the tension we may calculate the velocity of the wind. This calculation is based on an exact knowledge of the relation between the tension and a given speed of wind [for the particular type of balloon.—Translator].

This relation being known for certain velocities, it may be calculated for the higher ones by applying the law that the tension increases as the square of the velocity.

2. *Anemometer.*—The anemometer is an instrument which determines the velocity of the wind by measuring the quantity which passes a given point in a given time.

3. *By soundings.*—By following with a theodolite the flight of a small balloon we can determine the speed of the wind for every 100 meters up to 3,000 meters. With the plane table and alidade the balloon can not be followed beyond 600 to 800 meters.

In addition to these methods, which are peculiar to the Aerostatic Service, there is a General Army Aerological Service, which supplies atmospheric data to all interested branches, and gives due warning of the approach of conditions which render aerial operations dangerous.

Forecasts.—The company officer should be able to make reasonable forecasts based upon the following:

The aspect of the sky, the form and color of the clouds.

The reading of the barometric curve.—A slow, steady drop presages a change of weather; a sudden drop presages a violent wind; and a fluctuation a squall.

Study and comparison of numbers of soundings will produce many interesting facts concerning the wind. They assist in a determination of the direction of rotation of the wind and in ascertaining the depths of the strata of different velocities.

Mist.—This need not necessarily interfere with observation. If it is a thin stratum close to the ground, it may be pierced by the observer if he will ascend to a sufficient altitude.

If the fog is aerial—that is, above storm clouds, it will be best to keep the balloon at lower altitudes.

However, if the fog is regularly distributed throughout the atmosphere observation is impossible.

The balloon should be used, nevertheless, to take advantage of any clearing, however slight, which appears within its range.

Clouds.—These are generally high enough—1,000 meters (above 3,200 feet)—so that they do not impede observation from the balloon.

Rainstorms.—Rain gives the balloon a surcharge of more than 100 kilos (220 pounds). This surcharge considerably lessens (temporarily) the ascensional force of the balloon. Persistent rain renders observation impossible.

Thunderstorms.—These may cause the destruction of the balloon by electrical discharge, even when of slight intensity, which may set fire to mixed air and hydrogen about the valve or directly to the envelope by a discharge between a cloud and the balloon.

Atmospheric electricity may affect the windlass personnel, who receive shocks from contact with the cable and the earth, and the observer in the car, who may receive a shock through the telephone head set.

If these discharges become serious, the balloon should be brought to earth.

The balloon is protected by a ground stake at the windlass, by wire ending in a tassel attached to the cable, and the same device attached to the valve.

Influence of hostile fire on the maneuvers of the balloon.—Successful hostile fire may cause the deflation of a balloon or its destruction by fire. This produces a considerable moral success for the enemy. Every possible useful means to avoid it should be undertaken.

Hostile fire may be time-fuse fire against the balloon in ascension or in its station on the ground, or percussion shell fire against groups of personnel or matériel.

The special German guns for use against balloons.—The 10, 13, 138.6 Austrian, and the 15 long are equally adaptable for both time-fuse and percussion fire.

Percussion fire.—This requires regulation upon an objective situated on the ground. To reduce the possibilities of its success the balloon should never be brought down within the range of the special balloon gun, and while it is in ascension nothing should be permitted beneath it but the windlass, which should be isolated, defiladed, sheltered, and disguised. In the vicinity of hedges or orchard it may be hidden and covered with branches or covered with a green cloth, or disguised when in meadows or in denuded terrains.

In so far as possible, stationing of vehicles or grouping of unprotected personnel within 900 yards of the windlass should be

avoided. The balloon maneuvering detachment should be stationed in trenches or other suitable cover in the vicinity or spread out in the nearby woods.

When there is little wind, protection against this fire may be secured by offsetting the attachment of the cable to earth from the windlass by letting off 400 to 500 extra yards of cable, and making fast to a suitable ground support at that distance from the windlass, and by constantly changing the position of the balloon to give the effect of its being displaced by light eddies.

Shrapnel fire.—This may be nullified by elevating the balloon to an altitude outside of the trajectory of the piece employed. A balloon located about 4½ miles from the piece and at an altitude of approximately 2,500 feet may be considered out of range of most pieces. However, to escape the fire of the 15-long an observer at this distance from the line must rise to 4,000 feet.

Distance of the balloon from the lines.—When the balloon is assigned to a sector, every effort should be made to push it forward as far as possible to increase its value as an observing station.

It must, however, particularly when it is brought to earth, be kept out of the zone of effective hostile artillery action. It must be borne in mind that the security of the balloon is guaranteed only by its distance from the hostile artillery.

Experience has shown that the position of hostile batteries in rear of the infantry lines varies essentially with the caliber and with the tactical situation of the moment.

On a well-established front an equilibrium is established between the opposing artilleries, and the position of the hostile batteries is generally such that the balloon when at a high altitude in ascension may be brought within about 3¾ miles without fear of damage from time-fuse fire.

On the other hand, as the percussion fire of the high-powered hostile gun (the 15 excepted) does not generally carry more than 10 kilometers (6¼ miles) within our lines, all maneuvering of the balloon on the ground (inflation and bedding down) may be executed without fear of destruction or serious damage at that distance.

If the line has salients or reentrants the conditions of approach thereto or removal therefrom vary, and should be modified accordingly. When the tactical situation ceases to be stable (deadlocked) an important rupture of the equilibrium is established in favor of the side which assumes the offensive.

The hostile artillery is withdrawn to positions farther in rear and its attention during the barrage fire is shifted to oppose the progress of the infantry. Aerial observers should take advantage of these favorable circumstances to approach closer to the lines.

However, the fire of the larger pieces, where the retirement is least on the zones in the rear of our lines, will not be sensibly reduced, and the rule governing the distances of points of maneuver on the ground should not be modified.

Altitude and zones of good visibility.—An open terrain is best observed by an observer if the angle line of sight has an inclination of one-tenth. (Height of the observation station is one-tenth of the distance to the point observed.)

From a balloon whose altitude is 4,200 feet and which is placed 4 miles from the hostile lines, one sees territory comprised between this line and one parallel to it, and 8 miles from a point on the ground below the balloon with a line of sight whose inclination is between 1/5 and 1/10. This terrain is very easily observed, and in ordinary weather it may be said that the zone of very good observation extends from the hostile first line to a distance of 3½ or 4½ miles beyond it. Generally, by increasing the altitude we increase the depth of the zone of good visibility.

The balloon should usually be elevated as much as possible; only occasionally, because of atmospheric conditions, should it maintain a low altitude; as a rule, ascensions should be to an altitude of at least 2,300 feet, because of the possible resultant danger from time-fuse fire at lower altitudes.

Note.—It may be stated that while the H balloon will carry a single observer to a considerable altitude, it will not take two observers with their instruments and parachutes as high as 3,000 feet. The same applies to the 900-meter (31,500 cubic feet) balloon.

Moreover, when there are two observers in the car their shifting causes a rearing motion in the balloon, with the result that the tension is decidedly greater than when only one observer is carried. However, the balloon will carry two observers above 3,000 feet.

Attack by airplanes.—Hostile airplanes attack balloons by bombing or by fire with incendiary bullets or by throwing incendiary grenades.

The bombing occurs only at relative high altitudes and is to be considered as only relatively dangerous.

The firing and throwing of bombs is done from airplanes which dive at the balloon, and is usually attempted when low, isolated, and slow-moving clouds permit these airplanes to approach without being seen from the earth.

A lookout is maintained whose duty is to announce the presence of hostile airplanes in time to permit of opening fire with machine guns of the company on those which are directed toward or are attacking the balloon. The observer is also armed.

The action of airplanes may be combined with the fire of the hostile batteries. This maneuver has for its object the forced descent of the balloon, with a view to catching it under gunfire during the latter part of the descent. In this case the balloon should be withdrawn and lowered; but this maneuver is inconvenient, as it momentarily breaks the telephonic communication with the batteries or headquarters.

SERVICES WHICH MAY BE EXPECTED FROM THE BALLOON.

The mission of the balloon is at once a mission of surveillance of the field of battle and of observation of fire.

GENERAL SURVEILLANCE.

Terrain, troops, convoys.—The observer in the balloon continually reconnoiters the terrain and reports any modification made by the enemy in the defensive organizations, and likewise movements of troops, trains, or convoys which are not hidden from view.

As he is directly connected with the telephone system on the ground, he is a permanent source of information to the commander on the movements observed, their importance, and their duration.

Activity of the hostile artillery.—A trained observer whose section does not exceed 30° may exercise a very efficacious surveillance on the activity of the hostile artillery. All German fire may be observed by the flashes or smoke. The observer in a balloon who sees a piece fire should seek to determine the corresponding point of fall. A trained observer would submit the data on the subject thus:

German battery situated (located by coordinates), having —— guns, caliber ——, is firing on such and such French (British or American) position.

Particular surveillance during the course of an action.—During the course of an action an observer who knows his sector thoroughly may furnish the commanding officer with the most valuable information concerning friendly and hostile troops.

He should signal the positions and shiftings of these troops, either by direct observations, if the nature of the terrain and the atmospheric conditions are favorable, or by conventional signals, Ruggieri pots, or rockets, which he should understand perfectly. This rôle is most important, and its success may be greatly facilitated by proper information to the pilot of the hour and disposition for attack, etc.

Opening barrage fire.—Rapidity of execution being essential to the success of barrage fire, the balloon may be utilized under the order of the commanding officer to warn the batteries, or to transmit the order to begin this kind of fire, by signals plainly visible to all—by day, by signal flags; by night, by searchlight signals.

Again, the observers in the balloon may be utilized to keep the commanding officer and the artillery informed of the enemy's preparations for attack. He should report signals of the enemy requesting the extension of the fire (behind our lines), the extension of hostile fire into our lines; after a violent preparatory fire, signals of friendly infantry demanding our own barrage fire. In certain conditions where these latter signals are not plainly visible, or where prompt intervention is absolutely necessary, he may be authorized to give on his own responsibility the signal to open the barrage fire.

OBSERVATION OF FIRE.

The observers in the balloon may assist with efficacy in the precise regulations of fire in their zone of good visibility, zone of 4 miles in rear of the hostile line. Due to their relative immobility, they should very easily observe the fire shot by shot, and so assist in a systematic demolition. They control the salvo fire by determining the different points of fall in the same order as the shots were fired.

By supplying two balloons which are in telephonic communication with each other, we may develop a bilateral system of observation.

It is well generally to use the balloon for the regulation of fire and the airplane to observe the effects of fire of precision.

But the balloon may be utilized to follow the whole course of a demolition.

When a great many balloons are used these are never very far from their batteries and observe the fire with relation to the line: Friendly battery, objective. The battery should not be disturbed if the line balloon objective is constantly changing, since the windlass is shifting, and in light winds the cable forms a catenary arch, on one end of which the balloon shifts about, so that the target is observed from different directions.

OPERATION OF AERO STATION IN A SECTOR.

1. *During the preparation.*—The preparation of an offensive necessitates an increase in the number of aerial observers in the designated sectors. Special effort is made to avoid attracting the attention of the enemy, so while the units are engaged in preparation for service, being inflated or located in a masked camp, no more than the usual number of balloons is authorized to ascend.

The various companies maneuver to the places assigned them, either by day or night, and occupy the fixed points of ascension without delay.

When the commanding officer deems the time suitable, the new balloons are sent up simultaneously or progressively. The divisional balloons observe the fire of divisional artillery (field and heavy howitzers). They assist in the general surveillance of the sector, but more particularly observe the front of the division and the zone of action of the divisional artillery.

The balloons attached to the heavy artillery are occupied in observing the fire of counter batteries, or fire of demolition on those hostile batteries whose emplacements are visible, and against the works of the second line which escape the fire of the field and siege artillery. They participate in the general surveillance of the sector, and more particularly of the zone of action of the artillery to which they are attached.

Certain balloons may be especially charged with special surveillance for the army of the space behind the hostile front (to observe trains, convoys, troops, balloons, etc.).

2. *During the attack.*—At the moment of the attack the divisional balloons observe the German batteries whose position has been revealed and report them to the divisional and heavy artillery. They follow the shiftings of the infantry and signal to the commanding officer the position of the French line, and later

the assembling and movements of the enemy. In addition to other duties demanded of them, they observe the fire against objectives in the second line. The balloons of the heavy artillery are especially charged with surveillance of the enemy's batteries which are in action and regulate the fire of the counter batteries if necessary.

3. *Forward movement.*—The balloons advance by bounds in liaison with the infantry and maintain telephonic communication as they progress.

In case of pursuit and unless there are orders to the contrary, each balloon company moves with the unit to which it is attached; the divisional companies move with the division; the companies attached to the heavy artillery, marching or resting, maintain their places with their artillery.

ORGANIZATION OF THE TELEPHONE SERVICE.

In order that the balloon service may function to the best advantage, it is necessary that permanent telephonic communication be maintained between it and headquarters and the artillery.

These communications are established on the following principles:

The observer in the balloon should be directly connected with the battery which is firing. Conversation between the observer and the battery commander should not be interrupted for an instant while the adjustment of fire is in progress. With this in view, the telephone system is organized as follows:

1. A single line connects the balloon car to the wagon or truck on which is the telephone switchboard. (One line for the transmission of orders concerning balloon maneuvers is run directly from this truck to the windlass.)

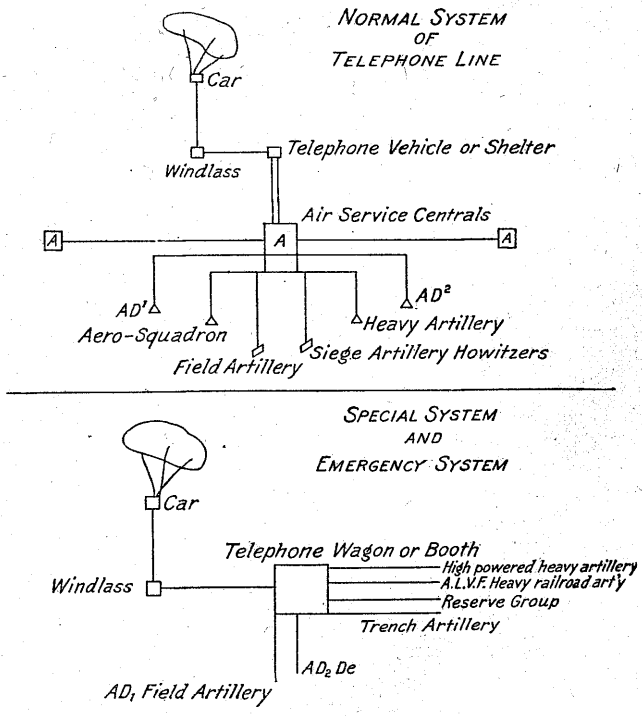
2. A double line from the telephone wagon to the Air Service Central. (For transmission of data from balloon.) One line is for the regulation of fire, one for conversation.

3. Double lines are run from the Air Service Central to the various artillery command posts, divisional artillery, heavy artillery of the sector, etc. Single lines connect the Air Service Central with the command post of the army corps and the command post of the artillery of the sector. In certain armies the Air Service Centrals are replaced by Centraux de Nappes.

These Nappes constitute a general system serving headquarters, the artillery, and the aeronautical service. The balloon

service has in this system two lines for the balloons to the artillery and one for the balloons to the commanding officer. So far as possible, each balloon is connected to a minimum of two centrals.

4. Double lines are provided in the artillery system for connecting each command post to each artillery command and each of these to each battalion.



5. A double line is run between the Air Service Centrals of adjoining sectors (for combined regulation of fire and exchange of data collected).

The double line has always one free wire which runs directly from the car to the battalion. This is called the "wire for regulation." The second, called the "conversation line," is for the purpose of transmitting to the artillery command data gathered by the observer (batteries revealed, movements of troops, of convoys, etc.), without interfering with the regulation of fire.

Each company establishes a special system consisting of lines from their telephone wagon or booth to certain particular groupings. (Counter batteries, A. L. V. F., A. L. G. P., etc.)

6. A reserve system consisting of the lines run direct from their telephone wagon or booth to the units which utilize the balloon.

These lines relieve the pressure of service on the Air Service Central and obviate the possibility of sudden interruption of communication in the central system. They are established and used as long as possible while installation lasts.

In general, it is desirable to connect the company central by direct lines to the heavy artillery battalions, but, as the lines joining their central to the groups of field artillery are frequently cut, it is preferable to connect those larger groups to these battalions. In this case the maintenance of the line between the larger and smaller groups is the work of the artillery.

The balloon companies are charged with the laying of the line to their telephone wagon and the lines in their own special and reserve systems. The rest of the lines are run by the army telegraph service (system joining the aero central) or by the artillery (system for fire control).

ARRANGEMENTS FOR AN ATTACK.

During the period of preparation for an attack the telegraphic service constructs, in anticipation of an advance, new centrals much nearer the lines. These are all for the purpose of establishing communication with the new command post provided for the artillery command.

For its part, the balloon company should decide on an itinerary which will enable it quickly to establish communication with the new system, without losing touch with the old.

During the advance it should cut in on the lines at points which will keep it constantly in communication with the new central by its forward line and with the old central by its rear line; or, in other words, by one line with the units which have advanced; by the other with those, which for the time being, maintain their relative position.

CHAPTER II.

FUNCTIONING OF THE SERVICE OF OBSERVATION.

I. GENERAL PRINCIPLES OF OBSERVATION.

A. *Orientation in the car.*—When the observer makes his first ascent in a sector he should devote the first hours he spends in the car solely to orienting himself.

To orient one's self means to search for, on the ground, well defined and characteristic reference points which strike the eye and may be used at later ascensions for picking up instantly the different regions of the sector. Reference points consist of points or lines which are easily identified, such as readily apparent crossroads, woods of a geometrical form, villages, buildings of large dimensions, isolated farms, regularly laid out gardens or parks, streams, roads, hedges, lines of trees, railroads, etc. Points at the longer range should be selected for use when there is good visibility and points in the immediate neighborhood of the line for hazy days when observation is limited.

The work of orientation is always difficult in a new sector and especially in those regions which have a generally uniform appearance. It soon becomes instinctive for an experienced observer.

B. *Knowledge of the terrain.*—The work of orientation is followed with a complete study of the terrain. This is first made on the ground with a map (map to scale of 1/50000, battle map to the scale of 1/20000) then completed in the car by a comparative examination with the map, with photographs and with the ground. As a final means, airplane flights give the observer an exact knowledge of the defiladed zones as seen from different angles.

This study of the terrain should be carried on methodically in the following manner:

(*a*) In the first place, find the plainly visible lines on the terrain whose trace on the map may be considered as exact. These lines constitute a triangulation which will aid in locating interesting isolated points.

(*b*) In the second place, determine exactly the location of German batteries which are plotted on the battle map, the

French batteries, the first French or German lines, more particularly at the points where previous combats have brought them close together and even confused them.

(*c*) Determine by the trace numerous hilly profiles of the regions visible from the balloon at different altitudes (2,500 feet, 3,500 feet, 4,000 feet). The object of this work is first to establish the map of the zones defiladed from the balloon, copy of which should be sent to headquarters and to the artillery for the purpose of dividing up the duties between observers on the ground, in balloons, and in airplanes, and secondly to make a close examination of the nature of the ground.

By completing this last work by perspective study of certain regions, where the apparent deformations of the line appear particularly interesting and by airplane reconnaissance, the observer may acquire a perfect knowledge of his sector.

This knowledge should enable him to identify immediately an enemy battery seen in action, to easily pick up on the ground emplacements of friendly batteries whose fire he has to observe; to avoid all errors in regulating fire directed against enemy trenches.

C. *Transmission of information.*—When the observer has obtained information with his own eyes he should first verify it, then fix it in his mind. Next, either mentally or in writing, he prepares it for transmission. This preparation should be made without haste, bearing in mind that moments given to reflection at this particular time will prove an economy of time, since it will result in simplifying the reading and consequently the interpretation of the information when it arrives.

When the working is ready to transmit it should be unvarnished, simple, clear, accurate, and precise.

Unvarnished.—As a general rule reports rendered should be unvarnished—that is, only what is actually seen should be mentioned to the exclusion of all personal interpretation of the observer. This applies particularly to the observation of artillery fire. If in exceptional cases the observer thinks he can draw interesting conclusions from the facts he has observed, he should then very carefully separate in his report what he has actually seen from the interpretation he puts upon it. Moreover, he should indicate clearly the reason for his interpretation.

Simple.—Simple wording means short sentences not intended for effect and employing usual language used in the service to

which it is addressed. All special military vocabularies should be familiar to the observer, especially technical artillery vocabulary.

Clear.—A clear text is one containing no sentences which may be ambiguous and one easy to read and interpret. The observer must remember that the one to whom he is transmitting information has not seen what he is talking about.

Precise.—In a precise message the words are weighed, used in their exact meaning, limitation, and import. In order that preciseness should not lead to the use of long definitions, which would interfere with the rapidity of transmission, schemes have been adopted which simplify a message; for example, the location of an objective is indicated by a system of coordinates by means of which the position may be defined simply by two numbers.[1]

Complete text.—A text is complete if all the different points of view from which information may be looked at have been examined; for instance, in information relative to the movement of troops the observer should mention the kind of troops, the formation, the strength, the route followed, the direction of march, the time they passed a given point.

NOTE.—The company commander should exercise constant oversight in the transmission of information. This is particularly important in tactical information, station and movements of friendly and enemy infantry, indications of attack, etc., on account of the serious consequences that may result in an error of transmission of information of this character.

D. *Observation material.*—The observer has in the car:

First. A rolling map board with the battle map of the sector pasted on the cloth.

Second. A pocket containing papers designated later.

Third. Three pairs of field glasses, one a 6 to 8 power, one a 12 to 16 power, one an 8 power with micrometric divisions.

In orientation and in observing fire the 6 to 8 power glass is used for a detailed study of the terrain; for demolition fire the 12 or 16 power glass is used.

Fourth. A searchlight or a panel for signaling to the infantry.

[1] Instructions of the 19th of January, 1916, in the use of aerial observation in connection with artillery. Index 1: Rules for the designation of emplacement of objectives.

II. DUTIES OF THE OBSERVER IN THE CAR.

In addition to special missions to which he may be assigned, as explained hereafter, the observer should always exercise initiative in reporting all the interesting facts that he may observe. In case the mission with which he is charged or the condition of visibility do not permit him to entirely complete the observation begun he so informs other aircraft (balloons and airplanes) which can complete the information that he was to secure.[1]

A. *General observation.*—An observer detailed to watch a sector is required to report all signs of the enemy, whether these signs are indicated by:

(*a*) Activities of his artillery.

(*b*) Movements of supply trains on the roads or trails, movements of trains on distant roads, movements of troops, whether concentrating or moving from one place to another.

(*c*) The construction of new works, lines of parallels, connecting trenches or shelters, bridges, foot bridges.

(*d*) Activity of enemy balloons.

Activity of the enemy artillery.—As soon as enemy battery opens fire it is revealed by the burst of its shells and by the flash of the discharge. The nature of the bursts and the character of the flashes enable a trained observer to determine the caliber—large, medium, small. By measuring the time between the discharge and the burst the observer can identify batteries which are firing on a given point; also the distinction between false batteries, which show the flash but no corresponding burst. As soon as the observer sees a German battery unmasked he should endeavor to locate its position, the number of pieces, the point on which it is firing, and its caliber.

Position.—Generally the flash is plainly seen; that is, the observer sees the flame at the muzzle of the gun. In this case the battery is readily located with respect to the surrounding terrain. This is marked on the battle map, either by tracing the front of the battery or of each individual piece, if the space between them is large. Position of the battery is generally given by the coordinates of its central point. It is well to locate it more definitely, if possible, by giving the coordinates of the flank pieces.

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[1] If, for example, a balloon observes movements of troops in the edge of a wood or sees flashes behind a crest he warns the airplane group which observes for troops or the location of the battery reported in action.

In some particular cases the flashes are seen behind a screen, edge of a woods, behind the crest of a hill with a steep slope on the far side, etc. In this case the observer fixes the alignment on which he saw the flashes. When this alignment is marked on the map it indicates the region in which the corresponding gun may be approximately located. In a country which is perfectly known and whose battle map has been perfected, the zone of uncertainty is extremely reduced. Moreover, to locate exactly the position of a masked battery requires the combined use of several balloons. The information obtained in one sector is communicated as rapidly as possible to the two neighboring sectors over the line of intercommunication. Telephonic communication is established from one car to the other, and a series of simultaneous observations is carried out. By intersection the alignments determined in the course of these special observations give the position sought.

Number of pieces.—The number of flashes and the number of bursts indicate the number of pieces. When the pieces fire at long intervals and the corresponding bursts can not be identified a prolonged observation is required to determine the number. It should be noticed that a variation in position of 150 to 300 feet, which may be made by one observer in two consecutive observations, generally comes from the fact that this observer identified the battery first by one of its pieces, then by a different one.

Point on which battery is firing.—The location of the objectives on which the enemy batteries are firing by using the connection between the flashes and bursts is easily obtained when the number of batteries in action is small or local. It becomes impossible, or very difficult, when the enemy releases a general fire or executes simultaneous fire. Now, it is just at these critical moments that the artillery needs to be informed as to the identity of the batteries whose fire they must neutralize first. As a result methodical and continuous study must be made in advance of the connection between known enemy batteries and the points that they generally select as objectives.

Caliber.—The observer determines the caliber by the nature of the flash and bursts. It should be noticed that great prudence should be exercised in indicating caliber. Unless certain of his information the observer should simply say large, medium, or small caliber.

With the ordinary caliber pieces experience has resulted in the following rules:[1]

Guns of 77-centimeter caliber are recognized by their short and bluish burst; 150-centimeter howitzers by a redder burst and a vertical projection of a light column of bluish smoke; 150 and 210 centimeter mortars are very readily recognized by the red flashes, accompanied by yellow smoke. The flash and smoke are more intense for the 210's. Thirteen-centimeter guns always show a very vivid light, more intense than that of the pieces mentioned above.

B. *Movements of convoys.*—Convoys on roads or trails indicate either regular provision trains or special supply trains (munitions) during the course of an action or the transportation of troops.

Regular daily convoys are rather difficult to discover on account of the precautions the enemy takes for masking them. They are finally discovered by watching constantly and attentively all the points they are obliged to pass.

On the other hand, during combat the observer has no difficulty at all in locating munition supply trains. These convoys move in the open and take no special precautions since their only object is to bring up their munitions as rapidly as possible.

Convoys of troops are easily seen on account of their size which renders all efforts to hide them of no value. In dry weather the dust thrown up attracts the trained observer's attention and enables him to locate vehicles at long distances.

In giving information of a convoy, the observer should always mention the nature of the vehicles (automobile trucks or horse vehicles), their number, route followed, and direction of march, the time of passing certain points.

Movements of trains.—Regular movements of trains are perfectly well known to an observer, who has been going up some time in a given sector. He knows the hours at which they pass the principal stations as well as the length of time they remain in these stations.

Information concerning the regular movement of trains should not be neglected, for it is a guarantee that no particular movement is being prepared in that section. Arrivals, departures, or abnormal passing of trains constitute, on the con-

[1] Instruction of the 20th of November, 1915, on the use of heavy artillery. Annexes and appendix, page 40.

trary, positive indication of a relief movement, of reinforcements or of a retreat. Movements noticed in front of an army are compared with those in front of the neighboring armies. Headquarters can gain valuable information from these combined reports.

As soon as the observer notices anything unusual in the daily movement of trains he should not lose sight of the railroad and should carefully note every train he sees pass. The following information relative to trains should be given:

"At such an hour a train B with N cars on such and such a line moved from such and such a station to such and such a station."

"At such and such an hour the train B stopped at station —— (or went through station —— without stopping)."

"At such and such an hour the same train B passed at such and such a point, the train E coming from the opposite direction and reported elsewhere."

A. Movements of Troops.

Daily movements.—Every day in each sector troops are being relieved and supplies are being sent up. These movements generally are made on hidden roads running through deep cuts perpendicular to the line. In this case it is difficult to discover them. However, it sometimes happens that troops prefer to march across open ground so as to cut down the distance or avoid ditches and difficult marching through meadows or encumbered trenches. They are especially likely to do this if they are not watched, in which case they come to count on the enemy aerial observer's lack of vigilance. The vigilant observer does not fail to see these movements and reports them at once, indicating their importance and their passage at given points.

Movements of concentration and movements during combat.—Concentration movements and movements of troops assume great importance during combat. Any troops seen and reported may be fired upon at once. Their fighting value may thus be annulled even before they are engaged. It is readily understood, therefore, how important it is to observe the terrain from this point of view. The observer should endeavor to estimate the strength of the troops he sees, the route they follow, and their rate of march.

Movements of large bodies.—Any frontal attack necessitates calling up the reserve and if it arrives during daylight it can

not escape the surveillance of the observer. Reinforcements are brought up either by railroad, which entails unusual movements of trains, or by automobile trucks (convoys), or in columns divided up among all the roads and trails available. In order that headquarters may act and concentrate all available artillery fire on these columns, it must be able to follow their movements step by step and minute by minute; it must know in particular the exact instant at which they converge on obligatory crossings. The observer with a reliable and rapid grasp of the situation, who knows his terrain well, can not only follow all these movements without difficulty but, in certain cases, can even foresee their itinerary and thus enable headquarters to take all the necessary steps above noted.

C. *New works.*—New works thrown up by the enemy are seen perfectly by the observer if they are not more than 5 or 6 miles from the balloon. Their state of advancement may be followed in detail and drawn in on the battle map. By continually observing these works, the rapidity of execution may be reported. From this headquarters can draw deductions concerning the position of the enemy, and in particular the aim pursued, whether reinforcing a line or increasing the communication with a view to attack.

D. *Enemy balloons.*—Enemy balloons in the air should always be reported. Headquarters may desire to know the number of balloons, the hour they go up, and the hour they go down. The number of balloons is generally a function of the amount of heavy artillery, and any reinforcement of guns of large caliber, especially mortars, is accompanied or preceded by the arrival of new drachens.

The observer has no means of locating the position of balloons in the air. He can only locate them in a vertical plane. However, he can report their height exactly by rising or coming down until he sees them projected against the horizon. At that moment he is at the same height as they.

Simultaneous observation from two balloons gives two alignments and consequently determines the position of the drachen by intersection. It is preferable, however, to execute this operation on the ground with a theodolite.

On the contrary, a balloon observer can fix exactly the point where a balloon is camped and the point where the winch is located. Prolonged observation enables the observer to watch the descent of the enemy balloon, its movements along the

ground, and the location of its camping place. This information is particularly interesting to the artillery, which alone is able to judge when it is opportune to open fire on the balloon.

B. Connection With the Infantry.[1]

During an offensive or defensive action and in favorable weather the trained observer follows the movements of the infantry. He may, for example, report the start of the successive assaulting waves and their progress, or report at a given instant the position of the infantry lines on the terrain after each bound.

In clear weather on bare ground free from smoke the observer sees the troops themselves, whether they are immobile, sheltered in shallow trenches or shell holes, or moving over open ground.

To render the observation more efficient it is very useful for the observer to be informed of the plan of attack and for him to have previously arranged with the infantry signalmen.[2]

In ordinary weather special connecting signals are the only ones that can be seen.

Flashes and smoke from Ruggeri pots can be seen perfectly and located when they are not masked. Rockets are plainly seen but can only be located at their starting point (the trace of the German rockets is very plain) or else at their point of fall where luminous balls continue to burn (French rockets). Infantry searchlights and panels are seen at a distance of 4 to 5 miles and under varying conditions of light. They may be used for exchanging previously arranged messages between the command posts of the advanced line and the balloon. Information which the observers obtain relative to the position of the infantry is transmitted direct to the division, sector, or army headquarters, depending on what the balloon company is normally assigned to or the special mission assigned to the balloon. The company commander should take particular pains to see that this information is transmitted judiciously, as its value

[1] Provisional regulations of April 17, 1916, on infantry connection with airplane and captive balloon.

[2] This arrangement should be practiced by signaling from the balloon to the infantry and from the infantry to the balloon every day. This connection is kept up as a rule, in daytime with stiff streamers in the hands of the infantry and floating streamers in the balloon; at night with searchlights (0.24 for the infantry, 0.35 for the balloon).

varies greatly, depending upon whether it arrives rapidly or slowly at the headquarters which is to take advantage of it.

C. Observation of Fire.

Previous arrangements.—In observing fire a complete understanding must be established between the officer directing the fire and the observer. Confusion and loss of time should therefore be avoided. Thanks to telephonic communication this connection may be kept up to the instant that fire is opened. It is established upon the following basis:

1. *Objectives.*—The commanding officer of the battery indicates the objective upon which he wishes to fire and the point relative to which he desires to carry out his ranging.

The observer informs him whether or not he sees the objective clearly, and especially the point indicated to him.

From what he sees he determines the nature of the enemy's protection and in particular its direction relative to the battery which is going to fire.

2. *Line of observation.*—The location of the line "battery target," relative to the line "balloon target," indicates what lines of observation the observer should take. If these lines make an angle less than 30 degrees the observation is always with relation to the line "battery target." If the angle is greater than 30 degrees, corrections are made, taking for departure the line "balloon target." In this case the coordinates of the balloon are transmitted by the commanding officer of the company to the battery commander.

In the case of A. L. G. P. fire (heavy artillery) the long range of the objectives necessitates using the line "balloon target" as the line of observation whenever this line makes an angle of more than 20 degrees with the line "battery target."

3. *Kind of fire.*—The battery commander indicates the kind of fire, the number of pieces to fire, whether the fire is by battery or by piece, the nature of the projectile, the kind of fuse, the approximate time of flight of the projectile. In case of fire by battery or by piece the observer asks to have the successive shots spaced at least five seconds apart so that he can identify them.

Observation of fire.[1]—The observer prepares his battle map by tracing the lines of observation. He locates two points on

[1] Instructions of Jan. 19, 1916, on the use of aircraft in connection with artillery.

the ground at the same range as the objective and measures the angle between them on the map or on an airplane photograph. He thus has a scale of comparison for estimating errors in azimuth.

In general it is difficult to measure errors in azimuth on account of the error which may result from the obliquity of the visual ray, particularly when the target is a distant one and hard to see or if the ground is irregular.

On account of the dispersion, it is useless to try to record an error in direction of less than 80 feet or more than 300 feet in the range.

As soon as the observer is ready he reports to the battery that he is "Ready to observe."

As each salvo or shot is fired the following communication takes place between the battery and the observer: "Ready to fire," "Ready to observe," "Salvo or shot fired."

As soon as he receives the warning, "Ready to fire," the observer gets the objective in the field of his glasses, sees the projectile strike and locates the point of fall. He locates it on the map and at once reports its position relative to the lines of observation in accordance with the rules already given.

Information relative to the direction always precedes information relative to the range. Information relative to the amount of error in azimuth always precedes information relative to the direction of the error.

Example: "Three hundred feet right; six hundred feet over."

As a rule figures are not given in reporting errors in range and only the words "Over" or "Short" are used.

However, when circumstances are such that the errors in range can be measured this information can be given; for example, when the artillery asks for it, when the heavy artillery is firing, or when the error is greater than 600 feet.

Errors in range may be measured in multiples of 300 feet; in direction they may be in multiples of 80 feet.

When the shot is plainly abnormal, the observer gives the coordinates of the point of fall.

When the shot falls plainly on the target and the damage is apparent—for instance, when the parapet or emplacement is overturned and shelter demolished, etc.—he announces "Hit."

In case he can not determine the effect, and in case he can not report the shot as being over or short, he reports, according to circumstances: "Doubtful" or "Doubtful, near the target."

Whenever during fire the point of burst of a shot is not seen, although the observer was in a position to see it, he announces "Not seen."

If for any cause the observer is not in a position to observe at the moment the shot strikes, he reports "Unobserved; I was not in a position to see."

For observations to be carried on properly, perfect telephone communication must be kept up between the observer and the battery. There should be no relay or intermediary. In this way delays in error of transmission are avoided.

The simultaneous observation of fire of several batteries should only be undertaken with the consent of the group commander. To be carried out correctly the officer in charge of the telephone service at the artillery central, if the batteries belong to different groups, or to the group central if the batteries belong to the same group, should personally take charge and maintain discipline on the conversation and give proper connection with the following battery as soon as the fire of the previous one has been observed. The undercommander should assist by constantly overseeing the telephone conversations and its observer and assuring himself that they are properly carried on.

In any event the observer can not observe the fire of more than three batteries, and in that case at least one of them must be a battery of large caliber, firing slowly.

III. ORGANIZATION OF THE SERVICE OF OBSERVATION IN THE COMPANY.

Each company of balloon troops has one officer and two noncommissioned officers rated as observers.

In addition to this, the units receive a certain number of officers and noncommissioned officers assigned from the artillery for a period of at least three months, one artillery officer and one artillery noncommissioned officer as observers.[1] During their detail the artillery observers are classed as balloon observers as soon as they show their aptitude for the service of aerial observation.

In addition, whenever circumstances permit, an artillery officer in each army corps is selected for training in balloon observation.

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[1] To facilitate instruction the number detailed should not exceed two per company.

The service of qualifying observers is divided up so as to assure—

1. Service of observation in the car.

2. Service of connection with the firing detachments (groups of artillery batteries and infantry units).

3. The proper rendering of reports and maintaining connection with headquarters, staff, and artillery.

1. *Service of observation in the car.*—This service is defined in the preceding paragraph.

2. *Service of connection with the firing detachments.*—(Artillery groups and infantry units.)

(*a*) In conformance with instructions which he receives from his company commander, the day after an ascension the observer goes to the groups of batteries with which he worked the day before. He gives them the results obtained, notes down their remarks, and endeavors by every means in his power to establish a complete, intimate, and reciprocal understanding.

(*b*) Before carrying out particular missions, such as regulating important fire or observing infantry during an attack, the observer should have a complete understanding with the others concerned relative to the conditions under which these missions are to be executed.

3. Reports and connection with headquarters:

A. *Reports.*—During his tour of duty in making reports the observer keeps up the regular reports under the direction of the officer observer who is charged with the service of information. This is done by taking down information coming from all sources of observation—airplane, balloon, aerial photographs, etc. The observer verifies and completes the list of enemy batteries as well as the list of objectives and of friendly batteries.

B. *Connection with the general staff and artillery headquarters.*—It is always well for the unit commander to have the observer next for duty with him when he makes his liaison visits. This enables the observer to take advantage of and exchange views. The service in question informs him of the object in view, and the observer, for his part, explains how he sees the terrain, and which of the operations to be carried out will be the easiest one to follow.

C. *Airplane flights.*—The aeronautical commanding officer arranges for each observer to make airplane flights for the purpose of completing his knowledge of the terrain in his sector.

Service roster of observers.[1]

	First day.	Second day.	Third day.
First detail, car	Observer A.	Observer C.	Observer B.
Second detail, connection with the artillery (artillery and infantry)	Observer B.	Observer A.	Observer C.
Third detail, reports and connection with headquarters (general staff and artillery)	Observer C.	Observer B.	Observer A.

[1] This roster is given as an example. Often connection with the firing groups must be kept up as explained in 2B above by the observers who are to observe following day.

Note.—Generally each evening when the observer leaves the car he should be very sure to give a detailed and complete report of everything that he has seen. All the information that he has gathered relative to the German artillery, defensive works, movements of troops, etc., that he has reported by telephone from time to time should be examined again as soon as this report is completed in conjunction with the observers from the balloons in the neighboring sectors and the squadron observers of the sector. A mutual comparison between all the observers who have been up prevents information concerning the same organization or the same movements being presented in a different form in their different reports, thus giving place to special interpretations depending on whether one or the other of them is consulted.

The information thus collected and coordinated is transmitted to its proper destination; that is, to the artillery (S. R. A.) to the headquarters of aeronautical service of the Army. The aeronautical commanding officer of the sector transmits this information.

CHAPTER III.

RECORDS OF THE SERVICE OF OBSERVATION.

Documents in the car.—The battle map and a pocket for various papers are kept in the car. These various papers include:

1. Photographs of the successive lines. These photographs are provided by the Aviation Photographic Service. They are fastened in books by cords; they assist the observer in following out his battle map and in establishing a perfect understanding relative to the objectives to be fired upon by the artillery with which he is working.

2. Map, scale 1/50000, of the zone of visibility of the sector. This map is pasted on cloth in sections about 8 by 10 inches. It is filled in with all the objects that can be observed and by a detailed examination of the airplane photographs.

3. A photographic reproduction of the battle maps of the neighboring sectors.

4. Map, scale 1/50000, of the entire front of the army, with standard-gauge and narrow-gauge railroads marked in color.

5. A sketch from memory of the French artillery groups, showing their zone of action.

6. Program of the work for the day, detailed list of the objectives on which batteries are to register.

Documents in the headquarters truck.—In the headquarters truck are:

1. Record of telephone conversations of the observer other than those relative to the observation of fire.

2. Record of the observation of fire, with the sheets relative to regulating fire grouped and collected for each day.

3. Record of German batteries, classified according to the square of the battle map in which they are located.

4. Record of the German batteries, classified according to the French objectives, on which they fire by the square on the battle map of the friendly zone.

5. Map of telephone connections.

6. Map of the zones of action of all the artillery groups in the sector.

7. A table containing description of the German batteries and description of objectives. Each description of a battery includes the following information:

Emplacement of the battery.

Characteristics of the battery (caliber, number of pieces).

Sketch of the square of the battle map, showing the battery in heavy characters and the neighboring batteries in light characters.

Objective of the battery.

Record kept up to date of the dates on which it was seen in action.

Record kept up to date of the dates on which it was subjected to counter-battery fire and by whom.

Each list of objectives includes the following information:

Designation of the objective.

Battery firing on it.

Dates on which the objective was fired at and by whom.

French battery which carried on counter-battery fire against it.

Various documents.—Map of defiladed zones from a height of 2,500 feet, 3,500 feet, and 4,900 feet.

ORGANIZATION OF THE BALLOON COMPANY.

1. General Organization.

The company is commanded by an officer with the grade of captain (or a lieutenant serving as a captain). It includes:

Officers: One maneuvering officer (first lieutenant or second lieutenant); 1 officer as observer.

Noncommissioned officers: Two noncommissioned officers as observers (not included in the total strength); 1 warrant officer; 1 assistant surgeon; 1 sergeant major; 1 quartermaster sergeant; 7 sergeants.

The strength given in the table below is applicable to all units. The number of drivers, assistant drivers, etc., is variable according to the type of the company and so is not enumerated.

2. Duties of the Personnel.

A. *Company commander.*—The company commander is responsible for the personnel and material assigned to him. He exercises command of the unit and assumes charge of its ad-

ministration and instruction. He is charged with the tactical operation of the unit and is responsible for the preservation and upkeep of the material. The company commander's duties relative to the personnel and the special points in which his responsibility lies are enumerated later.

3. Duties as Instructor.

The company commander should carry out, with all the means at his disposal, the theoretical and practical instruction of his unit and of his observers with a view to obtaining from each of them perfect knowledge of the service in which he specializes. To obtain this result he must be perfectly familiar with all the details of the company's duties and especially those questions which refer to aerial observation. With these in view he should make balloon ascensions and airplane flights, especially when he is sent into a new sector, in order that he may become well acquainted with the terrain and the conditions of observation.

In addition he should develop the general and technical knowledge of each of his officers and noncommissioned officers in order to qualify them to fill the next higher grade in case of necessity.

In particular he should continually look out for the physical condition, energy, and moral qualities of his observers. With a view to filling immediately the position of the regular officers when they are physically disqualified, he should expedite instruction of candidates for the position of observer. During all periods of inaction, whether it is a prolonged inaction behind the lines or temporary inaction caused by bad weather, they should be utilized for the instruction of all the personnel and especially for preparing specialists. Small schools under the direction of noncommissioned officers should be organized—rope makers, fabric workers (under the noncommissioned officer in charge of the balloon mechanicians), mechanicians (under the senior mechanician sergeant). The unit commander should endeavor to have each soldier assigned to some special work.

Assignment of the personnel of the balloon company.

Designation of the units.	Sergeants.	Corporals.	Privates.
Maneuvering detail:			
Maneuvering sergeant	1		
First maneuvering squad		1	10
Second maneuvering squad		1	10
Third maneuvering squad		1	10
Fourth maneuvering squad		1	10
Fifth maneuvering squad (lookouts)		1	5
Sixth maneuvering squad (lookouts)		1	5
Reserve detail (kite men and machine-gun details):			
Sergeants	1		
Corporals		2	
Privates			12
Riggers:			
Rigging sergeant	1		
Rigging squad		1	8
Telephone detail:			
Telephone sergeant	1		
Telephone operators		1	9
Observation detail:			
Noncommissioned observers	2		
Sergeant recorder	1		
Recorders			2
Winch detail:			
Winch sergeant	1		
Winch squad		1	3
Truck train:			
Sergeant truckmaster	1		
Truck drivers [1]			
Property clerk			1
Assistant truck drivers [1]			
Repair detail		1	3
Gas-cylinder train; gas detail		1	2
Horse-drawn train [1]		(2)	(2)
General company duty			

[1] Variable according to type of company. [2] Obsolete.

Duties as Technical Chief.

The unit commander should make frequent and detailed inspections to see that the material is in perfect condition for use. He gives detailed instructions for the preservation and upkeep of material and holds the noncommissioned officers in charge of the different sections responsible for carrying out these instructions.

Duties in Tactical Use of Balloons.

Connection.—The company commander connects up daily with the commander of the sector in which he operates (A C, or the aeronautical commander of the sector). This connection serves a double purpose, as it furnishes headquarters with a complete

report of information accumulated by observation in the course of the day and also puts the unit commander in touch with the tactical situation at that particular time. A close connection is established with the artillery commander and, in case of necessity, with the group commanders, with the battalion commanders, and with the battery commanders with whom the company regularly operates.

The company commander should make use of these connections to keep in touch with:

1. Proposed operations.

2. General and special missions of the artillery units in which he may be called upon to observe, and in particular in the zones of action of these units, the organization of counter-battery operations, with duties in connection with finding the range for artillery fire and demolition fire, etc.

3. The operation of friendly artillery (fire which was carried out the evening before) and of the enemy's artillery (batteries actually seen in action).

DUTY OF THE COMPANY COMMANDER IN CONNECTION WITH THE TACTICAL USE OF THE BALLOON IN ITS SECTOR.

(*a*) *When the balloon arrives in its sector.*—The unit commander is personally responsible for the preparation for inflation, for preparing the balloon bed, for preparing the point from which the balloon is to ascend, for the itinerary followed in transporting the balloon from its bed to the point where it is to be sent up.

He should personally reconnoiter the terrain and publish the results in a company special order.

If the position of the enemy's line is changed as the result of combat, points chosen by the company commander should be changed at once, and for this purpose he utilizes the results of the previous reconnaissances referred to above.

As soon as the location of the point of ascension is determined upon, the unit commander establishes his telephone system.

(*b*) *The balloon at its station.*—The unit commander is responsible:

For the time at which ascensions begin and end;

For the protection of the balloon, observer, and maneuvering detail;

For the regular operation of the service of observation.

Consequently he should—

First. Issue his orders for reveille and assembly so that the balloon will be in the air and the observer ready to observe as soon as daylight permits and see that he does not leave his station until nightfall. (Night ascensions are, as a rule, ordered by headquarters; however, in case of a surprise attack the unit commander should take the initiative and direct a night ascension.)

Second. Verify the fact that the officer in charge of the operation of the balloon has taken all the necessary steps to assure—

Protection against airplanes (lookout detail).

Protection of the balloon (machine-gun detail).

Protection of the winch and of its personnel (construction of shelter for the winch and for its detail).

Continual observation of atmospheric variations (wind, barometric pressure, sounding, tension on the cable, appearance of the sky, atmospheric electricity).

Third. Make frequent inspection of the information gathered by his observers, both from the point of view of accuracy and of accuracy of transmission.

Fourth. Assure efficient telephone service, and see that information is transmitted in time to be of use.

(*c*) *Changes of position in the rear of the lines.*—The unit commander is responsible for the organization of his trains, for the routes followed, for their regular operation, and for their rate of march. Consequently he should issue written orders as to the composition of the convoy, its maximum speed, the length of marches, halts for inspection.

He should designate the responsible chiefs for the head and rear of the convoy, regulate the distance between trucks while en route and at the halt, etc.

If the company moves the balloon, he should not forget that it is contrary to orders to cut any telephone or telegraph line, and that he is responsible for the preservation of lines of communication while passing them.

Maneuvering officer.—The maneuvering officer is also a company officer, and consequently it is his duty to carry out the regulations in force and the instructions of the company commander relative to the interior economy of the unit (usual duties, cantonment, hygiene).

He is assisted in this duty by the warrant officer.

Duties in tactical use of the balloon.—The maneuvering officer is responsible for the execution of all the maneuvers of the balloon.

While complying with the general program, outlined by the unit commander, he is given every initiative for making the necessary modifications.

Inflation.—The officer calls upon the sergeant in charge of the maneuvering detail for the preparation of the ground, upon the sergeant of the rigging detail for handling the balloon during the inflation, for the truckmaster for the movement of trucks and for the supply of hydrogen.

Organization of the camp.—After personally looking into the details, the officer assigns the preparation of the camp to the sergeant in charge of the maneuvering detail. As soon as the balloon is inflated and tied down, he makes the necessary guard details.

Transporting the balloon on the line.—For transporting the balloon to the point at which it is to ascend, the officer sees that the men are properly divided into squads, and looks out for their protection from fire while moving. He makes the lookout details and the machine-gun details which are responsible for the safety of the balloon while it is being moved. He personally sees to keeping up communication between the observer and the winch. He gives the winch sergeant his instructions for moving the winch. Last of all, through the sergeant in charge of the maneuvering detail, he verifies the preparation and upkeep of the route usually followed (keeping up the paths and culverts, points prepared for crossing telephone lines).

At the point of ascension.—For taking care of the balloon at the point of ascension, the officer directs the sergeant in charge of the maneuvering detail to construct a shelter, the plan for which he has previously drawn up. He provides cover for the material and personnel, personally assures the organization and regular operation of the service of protection in general. While the balloon is in the air, he should continually watch the condition of the atmosphere and see that the balloon is properly maneuvered (ascent, descent, withdrawing, hauling down with pulley). He has the authority and the responsibility for these maneuvers.

The maneuvering officer is responsible for establishing the telephone connections according to the plan drawn up by the unit commander, and is responsible for the regular operation of the system and of the switchboards. The services of the telephone sergeant are utilized in this work.

In movements behind the lines the maneuvering officer is in charge of the train and is responsible for conducting it.

Technical duties.—The maneuvering officer is in charge of the material of the company. He is assisted by the truckmaster in everything concerning the accountability for material in store and also in moving from one point to another. While he gives the truckmaster immediate charge of the property in store and of the movements of the train, he retains the responsibility for preparing and ordering the issue of supplies of balloon and mechanical material required for replacement and also expendable stores and hydrogen. Every day he inspects the repair service and for this purpose he has at his disposal:

For mechanical material, a squad of three mechanicians, including a corporal in charge and a truck mechanic.

For the balloon material, riggers who are all specialists, such as cordage experts and fabric experts.

Observer.—The observer is an officer or a noncommissioned officer on special duty in the company. Only under exceptional circumstances and when so ordered does he perform the duties of a company officer or noncommissioned officer. On the other hand, he may be detailed by the unit commander for special duties for which he may be especially qualified, such as supervision of the telephone lines, of the lookout details, of the machine-gun details, etc.

During ascensions the company commander should drop all other duties except those connected with his mission and should devote himself with constant vigilance to looking out for the security of the observer.

Duties of company observers, both in the car and on the ground, are specified in Chapter II.

LIST OF RECORDS TO BE KEPT UP TO DATE IN A COMPANY.

By the maneuvering officer.—Diary of operations. Diagram of telephone liaisons.

By the observing officer.—Papers kept in the car and papers kept in the headquarters truck. (See Ch. II.)

By the sergeant recorder.—The following records are kept up by this especially trained noncommissioned officer:

First. Accurate record of telephone conversations between the observer and the artillery. To this record is attached an accurate transcript of the spotting of artillery fire.

Second. Accurate record of the work in general performed by the observer during the course of an ascension except spotting of artillery fire.

By the sergeant truckmaster.—Daily inventory; receipt book for issuing material; inventory of material in store; record of issues and receipts of property issued for replacement, expendable property such as gasoline, oil, gas, etc.; record of correspondence (letters, messages) concerning relations with the following services which furnish material to the company: Aeronautical depot, truck train depot, telegraph service, engineer service.

COMPANY NONCOMMISSIONED OFFICERS.

Warrant officer, company duties.—The company duties of the warrant officer are those laid down in regulations.

Technical duties.—From a technical viewpoint the warrant officer is assistant and the eventual substitute for the maneuvering officer.

Sergeant major, quartermaster sergeant.—They are responsible for the ration accounts and for the cantonment, all according to the regulations in force.

Sergeant truckmaster.—The truckmaster is the direct assistant of the maneuvering officer in everything connected with material. When performing his duties he has under him:

Gas cylinder detail of one corporal and two privates, who are especially trained for this work;

A repair detail—one corporal, two privates (mechanics), and one truck mechanic.

He fulfills the functions of:

(*a*) Accountable noncommissioned officer, and as such keeps up the following records:[1]

Daily inventory: receipt book for issuing material; inventory of material in store; record of issues and receipts of property issued for replacement, of expendable property such as gasoline, oil, gas, etc., record of correspondence (letters, messages) concerning relations with the following services which furnish material to the company: Aeronautical depot, truck train depot, telegraph service, engineer service.

(*b*) As truckmaster he is responsible for—

First, while the company is permanently located at a given point.

[1] Regulations of the 3d of August, 1916, on the accountability for aeronautical property in the army.

While the units are stationary, periodical and detailed inspection of the trucks. Repair of the motors, chassis, truck bodies, periodic painting of the above, the upkeep and repair of the flexible tubing manifolds for emptying the gas cylinders.

Second. *While the unit is moving,* strict observance of the orders and instructions for the march.

Hasty inspection of the trucks at each halt.

Reconnaissance of the parking sites, keeping them in proper condition.

Third. *During operations* (inflation, manipulation, and emptying of the gas cylinders).

Movements of the gas cylinder trucks at the point of inflation (successive arrival, placing, lining up, removing, and the upkeep of the roads followed by the trucks).[1]

Rigging sergeant.—He is responsible for the upkeep of the balloon material and for having it ready for an ascension. By frequent inspections of the balloon and cordage he verifies its condition, and if necessary directs its immediate repair.

While in operation he takes charge of the balloon during the inflation. In this work he is assisted by 1 rigging corporal and 8 rigging privates, of whom 5 are cordage experts and 3 fabric experts.

Sergeant of the maneuvering detail.—He is the assistant of the maneuvering officer in the execution of the various movements of the balloons. In charge of the work of preparing the terrain he has immediate control of the squads detailed for improving the roads, for the construction of shelter, for the preparation of camping ground.

He is assisted in his duties by the squads of the maneuvering detail.

Squads 1 and 2 are detailed particularly for maneuvers with the pulley.

Squads 3 and 4 are detailed particularly in preparing ground.

Squads 5 and 6 are the lookouts. The reserve squad includes the machine-gun operators and kite men.

Telephone sergeant.—He has charge of the construction and upkeep of the telephone system, also the upkeep of the electrical

[1] Replenishing gas supply is always done under the direct orders of the truckmaster and as a rule under his direction. When the company is stationed for any length of time at a given place the truckmaster may delegate this duty to the corporal in charge of the gas cylinders on condition that the latter has sufficient ability to perform this duty.

material of the train. He is assisted by the telephone corporal and has under him five telephone operators and four pioneers.

Sergeant recorder.—He is responsible for keeping up the records of observation and of information in the company. He records all the information furnished by the observer, looks out for the telephone lines, and oversees the sounding operations.

Each company should have an order showing the division of duties among the technical noncommissioned officers in the upkeep of the trucks and loading them.

PERSONNEL OF THE SQUADS.

Maneuvering detail.—The personnel is divided up into squads according to their qualifications, and in addition to maneuvering the balloon they are assigned particular duties, as follows: Squads 1 and 2 are especially detailed for maneuvering with the pulley. They are recruited among the candidates for the position of repair men. These men are given instruction in cordage and in fabric working.

Squads 3 and 4 are used in preparing the ground, constructing shelters, arranging the camp, repairing trails, etc.

Squads 5 and 6 comprise the lookouts. They alternate in this duty as frequently as atmospheric conditions require. They are recruited among men with excellent eyesight, and are given a very complete instruction on the silhouettes of the different types of flying machines—French, allied, and enemy.

The reserve squad includes in particular the machine-gun operators—1 corporal and 5 privates each.

MATERIAL.

The train of the balloon company is divided in two sections.[1]

The first section or combat section is the one that accompanies the balloon. It comprises (see accompanying table):

The winch.

The tender or camp equipage wagon.[2]

The switchboard truck and its trailer or the telephone wagon.

The second section or supply section includes trucks for spare parts and the truck for supplies.

Spare-part truck—Supply trucks.—Gas-cylinder trucks and trailers, ration and baggage trucks, various trucks and wagons.

[1] In the automobile companies, 1915.
[2] In the 1915 companies.

AUTOMOBILE COMPANY, 1915.

FIRST SECTION.

1 winch truck.
1 tender.
1 telephone truck.
1 telephone trailer.

SECOND SECTION.

1 truck for spare parts.
1 trailer for spare parts.
5 gas-cylinder trucks.
5 gas-cylinder trailers.
1 ration truck.
1 baggage truck.
2 trailers for personal equipment of men.
1 general supply truck.
1 light supply truck.
1 kitchen trailer.
1 light personnel car.

COMPANIES, 1915.

FIRST SECTION.

1 winch.
1 camp equipage wagon.
1 light telephone wagon.

SECOND SECTION.

1 spare-part wagon.
3 gas-cylinder wagons.
1 light supply wagon.
1 ration and baggage wagon.
1 transport wagon.
1 rolling kitchen.
1 light personnel wagon.

FIRST SECTION.

The winch is used in sending up the balloon and transporting it.

The tender or camp equipage truck is used in transporting and maneuvering the balloon. It contains equipment for crossing obstacles and for establishing camp.

The telephone truck or wagon supplies the advance telephone central. It transports the ranging instruments, technical records, and has a trailer or cart attached for use in installing and keeping up the telephone lines.

SECOND SECTION.

The spare-parts truck or wagon transports the balloon material. The gas-cylinder trucks or wagons are used in transporting and renewing the hydrogen supply and in transporting the material for inflation and replenishing the balloon with gas.

The ration and baggage trucks or wagons carry the rations and baggage.

CHAPTER IV.

TECHNICAL REGULATIONS FOR THE USE OF THE BALLOON.

Technical reconnaissance of a sector.—The reconnaissance of a sector preparatory to using a balloon entails the following: Location of the point for inflation; location of the point for the balloon bed; location of the point for ascension; location of the route of approach.

Before carrying out this reconnaissance the balloon officer should be informed: As to the mission the balloon will have to fulfill; the date and hour at which it should be ready to ascend; tactical situation, including position of the lines and activity of the enemy.

A. POINT FOR INFLATION.

Tactical considerations—Choice of point for inflation.—The enemy should be kept in complete ignorance of the inflation of the balloon when it arrives in the sector, and should not be aware of its presence until the moment it is in use. To fulfill these conditions the point of inflation should be far enough to the rear and on ground entirely defiladed from the view of the enemy's observers on the ground, in kite balloons, or in airplanes. On the other hand, the point of inflation should not be too far away to prevent the immediate use of the balloon without loss of time as soon as the order for ascension is given. As a general rule the point of inflation should be in a zone from 6 to 7 miles to the rear. Six miles is sufficient to give the balloon protection from the enemy's long-range fire; 7½ miles is the maximum distance permissible.

Technical considerations—Access.—The point chosen should be near roads of easy access, so that the material can be brought up to the vicinity without difficulty. These roads should be such that the truck train and the gas-cylinder trucks or wagons can get away, even during inflation, if necessary. It is especially important that the gas-cylinder trucks and their trailers should be able to turn around without difficulty. If necessary the ground should be prepared so they can do so.

Space required.—The terrain selected should give sufficient open space for spreading out the balloon and moving around it (about 100 feet by 50 feet). It should be near enough to the service road so that the inflating tube need not be too long, as this results in a loss of gas. One hundred and sixty feet is the maximum allowable distance between the center of the ground cloth and the road. The ground should be dry enough without being too hard, as would be the case in the site for the balloon bed, as it is not necessary to anchor the balloon to the ground at the point of inflation.

Wind.—The point selected should be sheltered from the wind. The action of the latter makes itself felt more and more as the balloon fills.

Thick fringes of trees, clearings, wood roads bordered with thick trees are good points for inflation.

The best shelter is a narrow clearing in the middle of a wood.

If sufficient natural obstacles are lacking they are replaced by an arrangement similar to that of a hastily prepared camp site.

General Arrangements.

Material required.

(*a*) *Gas cylinders.*—The elongated captive balloon of 830 cubic meters (about 29,000 cubic feet) requires 140 cylinders and the balloon of 900 cubic meters (about 32,000 cubic feet) requires 150 to 160. It is well to provide a few more tubes than are actually required in estimating 220 cubic feet per tube.

(*b*) *Trucks.*—The trucks brought up to the point of inflation are: The gas cylinder trucks or wagons; the spare-part truck or wagon; the tender or camp equipage truck.

Personnel.—Inflation is operated under the direction of the maneuvering officer, or, if he is not there, by the adjutant with the following personnel:

(*a*) The rigging sergeant in charge of the balloon during inflation;

(*b*) The rigging detail and squads 1 and 2 of the maneuvering detail in charge of handling the balloon;

(*c*) The gas cylinder squad in charge of the manipulation of the gas cylinder manifolds.

The ground is prepared in advance by squads 3 and 4 under the supervision of the maneuvering sergeant.

The movement of the trucks is under the direction of the truckmaster. As soon as the inflation is completed he is

directed to proceed to the refilling station to have the tubes refilled.

Length of time required for inflation.—The balloon may be inflated in an hour by auto-truck companies, type 1915. It takes two hours with the other companies. With the auto-truck companies, type 1915, the rapidity of inflation is a result of methodical use of the material with which they are provided. The gas cylinder trucks are grouped in pairs. The first group takes its position and is made ready while the balloon is being laid out. The second group is prepared while the first two trucks are being emptied. It moves up to the inflating tube as soon as the preceding group has cleared. In the companies not provided with trucks the gas cylinders are unloaded in two equal piles separated by a space of 10 feet in which the manifolds are placed. When the first manifold is attached these tubes are emptied. During this time the second manifold is being attached, and so on continuously.

Replenishing.—Replenishing is a partial inflation of the balloon required after each ascension. The balloon should also be replenished after it has been tied down several days and has lost gas through changes in temperature and pressure. Replenishing should never be done except in the evening. At that time the gas is still warm and less is required to fill up the balloon.

The object of daily replenishing the gas is to keep the balloon filled out so that the air can not enter. If the balloon is not kept full, the gas depreciates through the entrance of air into the empty space.

Replenishing should be limited as a rule to 3,500 cubic feet (17 cylinders). Complete renewal is necessary from time to time in order to verify the action of the automatic valve.

The operation of replenishing is not carried out at the balloon bed unless the terrain is easily accessible to the trucks. As a rule, a point is selected on a road in the neighborhood of the camp. It must be remembered that it is easier to move the balloon over varied ground than a gas cylinder train.

B. THE BALLOON BED.

Selection of the point—Tactical considerations.—When the balloon is in camp it should be sheltered from enemy fire, defiladed from the view of observers on the ground and in drachen balloons. As far as possible it should be masked from the view of the aviators.

As a rule the balloon bed is selected about 6 miles from the lines, but in case of a successful offensive action the bed may be farther forward so as to take advantage of the withdrawal of the enemy's artillery.

However, it may be stated as a general rule that the bed should not be less than 4½ miles from the lines. In looking for a camping point not only the defilade of the point selected must be taken into consideration but also the immediate neighborhood. This is for the purpose of enabling the company to bring out and prepare the balloon out of sight of the enemy's fixed observing stations.

Technical considerations.—A space 100 feet by 30 feet is required. The ground should be solid enough to hold the iron screw anchors, or, better yet, wooden anchors, which are stronger and not so hard on the cordage.

Protection against the wind.—The balloon bed should be completely sheltered from the wind. Clearings cr openings cut in the edge of woods make very good sites if the ground is good. The north edge of a woods of high trees has this advantage, that the trees throw their shade over the balloon and help to conceal it. If the only shelter is scattered trees, the intervals should be closed with screens hung up on wires stretched between the trees.

If the natural cover is insufficient, it should be completed by hurdles set at an angle against the wind.

If the terrain is entirely uncovered, the ground should be dug out so as to lower the balloon as much as possible. The soil is thrown out to the side and held at an angle by hurdles.

During the day when the balloon is in the air, the ground cloth must be removed and steps taken to efface the regular lines of the outline of the bed by means of branches, grass, or irregularly placed screens.

As a rule no vehicle should come to the bed. Only under one condition is gas replenished at the bed. It is where a road or line of easy access passes near the place selected.

General arrangements.—Preparation of the balloon bed: Preparation of the balloon bed consists in preparing a slightly rounded surface, which is covered with sand or light branches, on top of which the ground cloth is placed.

A ditch dug around the outside catches water and runs it off into a drain. To facilitate moving around the balloon, a path is built and covered with a board walk.

A telephone line connects the post of the guard with the bed.

Detailed arrangements.—Orders for the balloon guard should be drawn up with the greatest care by the company commander, and he should assure himself that they are carried out in the most minute detail.

INSTRUCTIONS FOR THE GUARD.

First. *Composition of the guard.*—One sergeant, 1 corporal, 9 privates, 2 privates of the rigging detail, 1 truck driver in case a truck is left near the balloon. As a rule the guard is detailed from regularly constituted squads.[1]

Second. *General orders.*—There should always be two sentinels, one on each side of the balloon. They are on post two hours at a time.

The sentinels are instructed to let no unknown person approach the balloon. No light or fire should be allowed within a radius of 300 feet. The guard is provided with a flash light. The noncommissioned officer of the guard should make frequent inspections to see that orders are carried out.

In case of a strong wind threatening the security of the balloon, the sergeant of the guard should immediately inform the company commander by telephone or orderly and from him receive necessary instructions.

Third. *Technical guard.*—From the technical point of view the rigger on the guard is responsible for the balloon being properly tied down, and in particular sees that the gas pressure in the balloon is normal, that the tying-down ropes and the maneuvering ropes are properly attached, that none of the rigging is on the ground, and that the ripping cord is attached to something solid.

Fourth. *Orders for the camp during ascension.*—While the balloon is in the air one of the rigging detail is assigned to look out for the camping site.

Before going to the point of ascension the riggers roll up the ground cloth, put it in a dry place, obliterate the outline of the balloon bed with branches, and turn the sandbags over so that the lower side will dry.

C. SELECTION OF THE POINT OF ASCENSION.

The distance of the point of ascension from the line varies with the tactical situation of the sector (offensive, defensive) and with the general trace of the front line (salient, reentrant).

[1] Squads organized for taking care of the camp, bringing supplies, etc., should be same as those enumerated in the organization of the company.

In a quiet sector the shortest distance from the line is 4 miles. In an offensive sector the balloon may be taken farther forward. If the enemy is drawing back his artillery very rapidly, it might at first sight appear that the balloon could be operated up to within a very short distance of the line, but its presence in front of the line occupied by friendly batteries would interfere considerably with the latter's fire and would place the observer and material in considerable danger. The cable might be cut, balloon struck, the car subject to the concussion of large projectiles. Experience has shown that under certain circumstances the point of ascension may be brought up to within 2½ miles of a new front.

However, this position should not be considered fixed, and the balloon should be withdrawn to the rear the minute it appears that the advance is halted for any length of time.

It must be observed that the balloon drifts with the wind and that it may approach or draw away from the line as much as half a mile with relation to the winch. For this reason it is well to have two points of ascension selected, one more advanced to be used when the wind blows from the direction of the line, the other more to the rear for use when the wind drives the balloon toward the enemy.

Certain topographical features may modify these rules. The presence of a large river or swampy stream, railroads running through cuts or on embankments, or large obstacles to be crossed, may necessitate moving the point of ascension farther back than the limits given.

Defilade from the view of observers on the ground or in drachens necessitates avoiding crests or ground sloping toward the enemy for points of ascension. The ground in the immediate vicinity should also be hidden from view so that the arrival and departure of the winch will not be seen.

The position of the winch should be hidden from view of aviators and selected so as to deceive the enemy. Consequently it should not be placed behind an isolated object easy to locate, such as a clump of trees, crossroads, cemetery, etc., but, on the contrary, should be in a location such that it blends in with the landscape.

Technical considerations.—Since the point of ascension should be readily accessible for a heavy truck, such as the winch, the ground should be solid and provision should be made for keeping it so in case of long rains.

To dig out a shelter the subsoil should be dry to a depth of 10 to 12 feet.

It should be possible to haul the balloon down in the immediate vicinity, consequently there should be an open space of about 1,600 feet.

If the point selected is in a wooded region, care must be taken to see that the winch is in an open space so that the cable will not be caught in trees. The cable should have a clear space when at an angle of 45 degrees.

GENERAL ARRANGEMENTS.

(*a*) *Trucks.*—The first section, including only three trucks, should come up on the ground—the winch, the tender, or camp equipment wagon, the telephone truck. When these trucks are not entirely hidden from the view of aviators they should be sufficiently separated so that one of them will not lead to the discovery of the others. A distance of 1,600 feet at least should be allowed between the winch and the tender, 1,600 to 3,000 between the winch and the telephone truck. The last two trucks are always removed from the probable line of fire directed at the winch.

For the telephone truck a place should be selected that is of easy access; this truck comes on the terrain by a different route from that followed by the winch, using good roads, if possible.

(*b*) *Telephone system.*—The telephone connections are established as explained in Chapter I. The reserve line and the special lines are run by the telephone squad. The general telephone system is laid out by the company commander. The reserve system is always installed over different lines from those of the normal system.

DETAILED ARRANGEMENTS.

Shelter for winches.—Two kinds of shelter are used for the winches—artificial and natural.

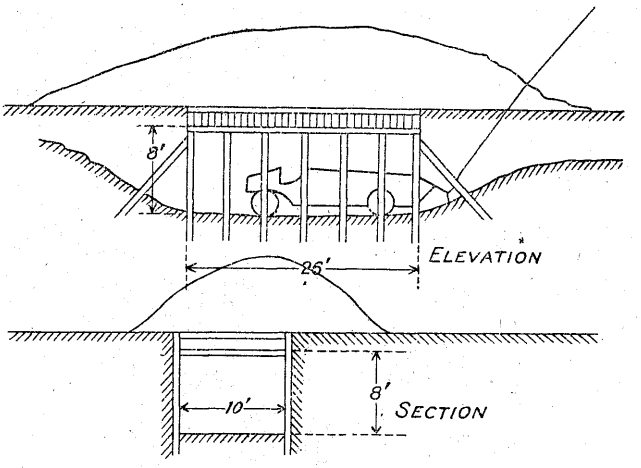
Artificial shelters are of different types, depending upon the winch:

(*a*) *Steam winch and winch with two motors.*—In these two models of winch the cable comes out of the middle of the carriage.

A shelter of earth and logs is built, the height of the shelter in earth in its natural state being calculated for angles of fall of 30° for shell fire.

(*b*) *Automobile winch, 1915.*—In the automobile winch, 1915, the cable comes out from the rear of the truck. The height of the truck is much less than in the other types of winch. Much less excavation is required in constructing a shelter for it. The shelter should be constructed parallel to the lines or in a slightly oblique direction.

The shelter may be constructed with two entrances so that, no matter what direction the wind may be, it will not be necessary to make use of the pulley.

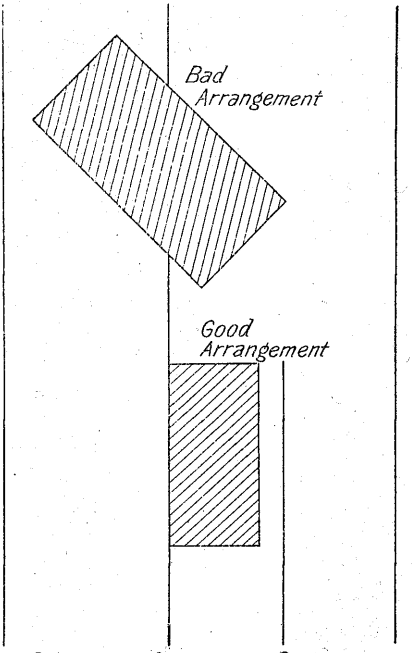


Overhead camouflage for the shelter.—The winch may be disguised with a canvas or a latticework of boughs, etc., furnished by the camouflage section. This is a rapid method and nearly always efficacious.

The appearance of the ground as seen from above should be considered; for instance, as seen from the balloon or by photographs taken from the air, the shelter should be so arranged that it does not break the existing color effect of the terrain. Particular care should be taken that the outline of the shelter does not cut the lines of cultivation even when the latter appear to be obliterated when seen from the ground. Paths should be covered up with grass cut some distance away. The position of these preparations, as well as that of the ground which is thrown up, should be masked with branches. An ef-

fort should be made to have the winches' shelter appear the same as the surrounding terrain. (Hay stack, manure pile, artificial woods, irregular hedge, etc.)

Natural shelter.—A deep depression may be used as shelter for the winch; in this case splinter proofs would be constructed. Sunken roads are sometimes found where, by cutting into the side, the road itself may be left clear. The cut is covered



SHELTER ON CULTIVATED GROUND

over with branches which hide the winch and partially conceal the smoke from it.

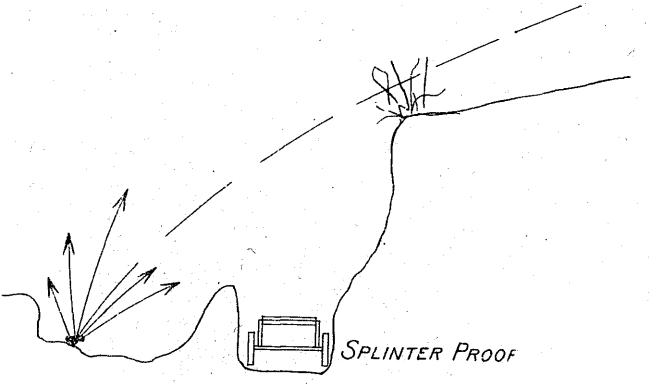
Quarries sometimes furnish good shelter without excavating at all. In this case a splinter proof is generally constructed.

Telephone shelter.—When the company has no office or headquarters truck, or when the nature of the ground is such that the headquarters truck can not be brought close enough to the winch (one-half mile or less) the company commander builds

a subterranean telephone station. In this are installed the switchboards for the special telephone system, for the auxiliary system, and for the line connecting up with the aeronautical central station.

Interior arrangement, floor, lights, etc., should be constructed with a view to accommodating the sergeant recorder and his assistants, also the observer.

Shelter for the men.—The men should be protected from the enemy's view, from artillery fire, and from projectiles thrown by aviators. Existing shelter in the neighborhood should be utilized, such as trenches, woods, and hedges, which may be improved or reinforced as required.



Post of the company commander during ascension.—When he is not called away from the point of ascension in answering calls from the general staff or artillery of the sector, the company commander should always remain by the telephone truck or shelter. He leaves this post when necessary to oversee the operations of the company at the point of ascension.

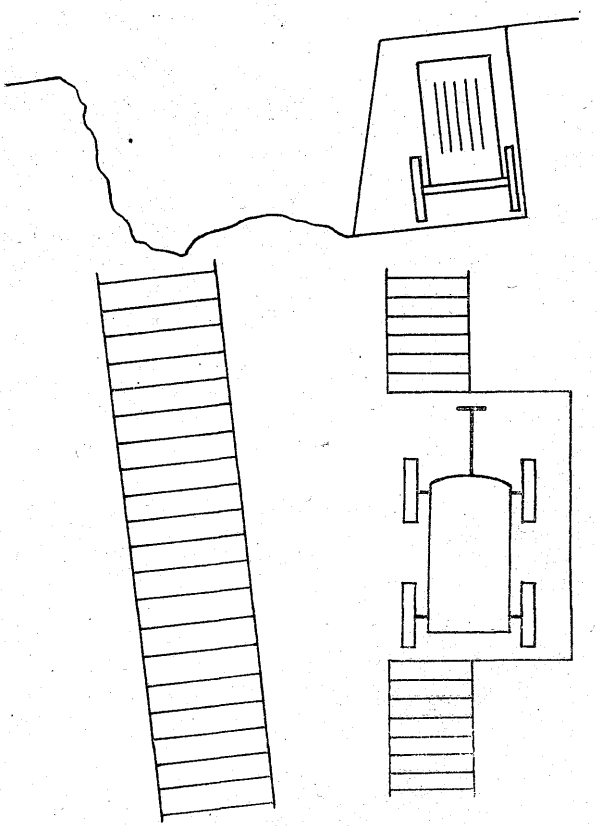
OUTLINE OF DUTIES OF THE MANEUVERING OFFICER AT THE POINT OF ASCENSION.

1. INSTRUCTIONS RELATIVE TO DIVIDING UP THE DUTIES OF THE PERSONNEL.

Maneuvering officer.—The maneuvering officer is responsible for everything that takes place at the point of ascension. He

should save the observer from any concern relative to the maneuvering of the balloon or his own safety.

The maneuvering officer should see that observation is carried on under the best conditions. If there is a mist up above or close to the ground, he should recognize it by examining the



clearness of the outline of the neighboring balloons. He regulates the height in accordance with the tactical or technical conditions previously noted. (Part 1.)

He watches the tension on the cable. In case of a strong wind he has the winch corporal take a written record of the

tension taken at regular intervals, the length of time between readings depending upon the danger of the winds increasing.

He watches the condition of the atmosphere for sudden changes and for electrical conditions (squalls, storms). He constantly oversees the lookout details and gives them frequent practice by signaling an alarm.

He frequently verifies the proper operation of the telephone connections by using them himself.

Winch detail.—The only one near the winch should be the winch detail, one winch telephone man, and a rigger to operate the reel and the reserve telephone line.

One of the winch detail is designated to assist the rigger at the reel and with him be responsible that the telephone cable is never stretched.

To provide for a rupture of the telephone cable the observer has 800 feet of telephone cable on a reel in the balloon. With this at his disposal he should not need to have the balloon hauled to the ground in case the telephone cable is broken.

Rigging detail.—The rigging detail remains at the tender. One of the riggers is detailed at the winch, as above stated.

Maneuvering detail.—The maneuvering sergeant places the maneuvering detail either in a special shelter or in the trench or under cover within whistle sound of the maneuvering officer.

If atmospheric conditions are such that the men are not required in the immediate vicinity of the winch, squads 3 and 4 will be put at such work as is necessary in leveling the ground, etc. However, they should not go much over half a mile from the winch.

Telephone operator.—The telephone operator assigned to the winch is under the winch shelter or in a small shelter adjoining. He must constantly see that the lines are open. (His instrument is shunted.) He is always ready to run over the line from the winch to the telephone truck if this line is out or works irregularly.

The other telephone men are divided as follows:

Corporal and four privates at the telephone truck ready to repair the line from the telephone truck to the aeronautical central, the special line, and the reserve line; the telephone sergeant and four men with the telephone cart are at the aeronautical central ready to repair the special lines to the balloon from the aeronautical central.

2. INSTRUCTIONS FOR PROTECTION AGAINST AIRPLANES.

1. Arrangements for observation and for protection. It includes—

(1) A squad of lookouts commanded by a corporal;

(2) Two machine guns provided with special sights;[1]

(3) A group of six sharpshooters.

The lookouts are provided so as to assure efficient observation, each man watching over a given sector. The corporal is provided with field glasses and one of the men with a bugle or instrument for sounding the alarm.

The personnel of the machine-gun squads[2] also assists in the duties of lookout, especially the distance and speed estimators.

As a general rule the two machine guns are placed as far forward as the balloon and about 160 feet on each side of the line from the balloon to the winch.

The squad of sharpshooters is placed in the neighborhood of the winch on both sides of the line from the balloon to the winch and on the side opposite the balloon relative to the winch. The sharpshooters are armed with the cavalry carbine provided with Chauchot loader, and are located in a trench with rests from which to fire. They are used principally when the ballon has been brought down to a lower altitude and the enemy aviator is masked from machine-gun fire. The maneuvering officer oversees, in a general way, the arrangements for observation and for protection. He arranges so he can see his men and direct them by voice. He is provided with a pair of field glasses with micrometer.

2. *What to do in case of attack.*—If an enemy airplane is seen the lookout corporal gives the alarm with the trumpet; he details one of the lookouts to follow it, the machine-gun detail prepares to fire, the winch detail verifies the operation of the winch and prepares to haul down the balloon. If the airplane heads for the balloon, the balloon corporal gives the alarm by means of two blasts of the trumpet, and the preceding arrangements are carried out.

The maneuvering officer oversees the preparations. On his signal, 3 blasts of the trumpet or whistle, the winch hauls down the balloon at full speed, the machine-gun operators opening fire.

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[1] Le Prieur Auto Corrector or Cottin sight.

[2] Each squad includes a leader and 5 others, as follows: 1 to estimate distance, 1 to estimate speed, 1 to fire, 1 to load, 1 assistant to the last named.

The sharpshooters open fire only when especially so directed by the maneuvering officer.

If the attack is successful and the balloon is set on fire, the maneuvering officer sends word by telephone to the observer to jump with his parachute. This warning is repeated by a series of a dozen short rapid blasts of the trumpet or whistle.

The maneuvering officer has the winch move to one side so that the burning balloon, as it falls, will not catch the observer and his parachute. As a rule it is not necessary to move the winch if the balloon is not on fire. The only objection to this is its separation from the machine guns whose fire is its best protection.

If the attack is given up or is not pushed and the enemy airplane withdraws toward its own lines, the maneuvering officer gives the signal that the danger has passed by sounding "Cease firing" or four long blasts of the bugle.

3. INSTRUCTIONS IN CASE OF BOMBARDMENT.

If the fire is percussion, the personnel remains under its shelter. If it is time fire, the maneuvering officer has the balloon let up and learns the height of burst from the observer.

In case of accurate percussion fire or a combined attack of airplanes and artillery, the maneuvering officer must decide whether or not he thinks best to draw back with the balloon and all the company during a lull in the fire.

D. ITINERARY.

Choice of route.—The route from the camping point to the point of ascension should be as short as possible. Moreover, there should be several different routes, so as to deceive the enemy as to the way the balloon moves.

Tactical considerations.—The route should be hidden as well as possible from the sight of observers on the ground and in the enemy balloons. This route follows valleys and wooded roads and crosses ridges perpendicular to their crests. In case of necessity, points which are visible to the enemy may be protected by artificial cover.

Technical considerations.—The route should be accessible to trucks in any kind of weather, wet or dry. It is prepared by

the balloon company with the assistance of the engineers and the telegraph service (crossing trenches, streams, telephone lines, etc.).

General Arrangements.

Formation of the column.[1]—The winch moves alone along the road; the tender follows it at a distance of about 800 yards and tries to keep it in view.

These two trucks transport the following personnel:

Truck.	*Tender.*
Maneuvering officer.	Sergeant of the rigging detail.
Winch sergeant.	1 private of the rigging detail.
Winch corporal.	Corporal of the machine-gun detail.
3 privates of the winch detail.	3 machine-gun operators (1 piece).
1 telephone operator.	2 drivers.
2 of the machine gun and lookout details.[2]	

The telephone truck transports the telephone central, the recorders, and a telephone operator direct to the point selected, taking a route over good roads.

The telephone cart follows the telephone truck. It leaves the telephone corporal and two telephone operators at the point where the telephone truck stops, then takes the telephone sergeant and the four remaining telephone operators to the aeronautical central, where it remains.

The maneuvering officer gives his instructions to the winch sergeant for bringing up the winch. It is advisable to move as fast as the material and state of road will permit, especially in crossing ridges.

The observer should be in constant telephonic communication with the winch. This is necessary so that the observer may feel at ease during the movement of the balloon, and also so that he can report anything of importance that takes place as soon as he is in sight of the enemy's lines.

The service of protection during the march is in the hands of the machine-gun operators and lookouts on the winch and tender.

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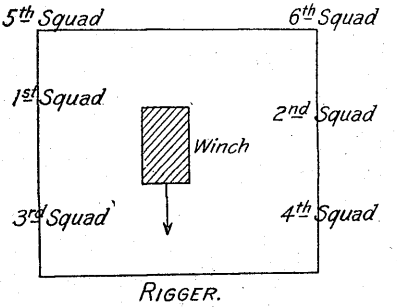
[1] The arrangement given refers particularly to automobile companies, but the principles are applicable as well to companies of other types.

[2] Distance estimator and speed estimator.

In good weather the men march in two squads, one in front of the winch, the other behind.[1] If the weather is uncertain the winch reduces its speed. In this case all the maneuvering detail form in a square around the winch, the men separated from each other by 50 to 60 feet.

All movements of the balloon should be executed very rapidly. To prevent the enemy's discovering the location of the balloon bed it should always be raised up and hauled down at points removed from the bed and at a different point as often as possible.



The maneuvering officer should carefully study the concealment of the route, especially in the neighborhood of the point of ascension.

DETAILED ARRANGEMENTS.

Telephone lines.—The most frequent obstacle met with on the road from the balloon bed to the point of ascensions is telephone lines. The following method may be used in preparing crossings:

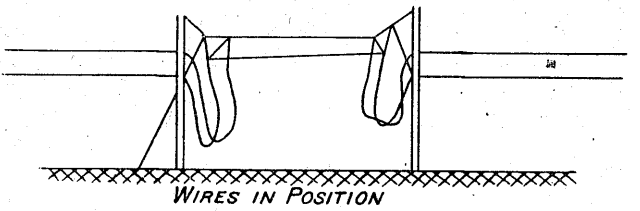
1. Run the separate lines through insulators in a trench dug in the ground. (The width of the opening should be at least three times the height of the wires above the ground.)

2. Rig up an arrangement with pulleys so that all the wires between two posts may be lowered and raised simultaneously.

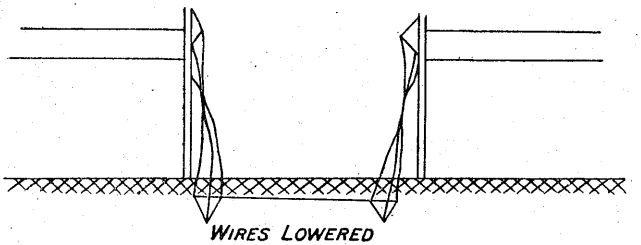
Two openings should always be made on the same route so that the balloon is not dependent upon a single one.

[1] The first squad starts as soon as the balloon has been attached to the winch. The second squad starts at the same time as the winch and as soon as the balloon has reached the desired height.

Halting points.—Points will be selected along the route where the balloon may be hauled down in case of necessity. This operation should be easy and rapid. The point selected should be such that the balloon is out of sight of the enemy as soon as it



WIRES IN POSITION



WIRES LOWERED

reaches the ground. A point called a halting point will be selected between the balloon bed and the point of ascension. The balloon halts here when there is some question as to the stability of the weather.